

What is claimed is:

1 1. An addition circuit for producing a sum of four redundant binary numbers, wherein each  
2 number includes an operand field and a sparse carry-save field, comprising:

3 a 4:2 compression adder for receiving each of the operand fields of the four redundant  
4 binary numbers, and producing a first sum field and a first carry field therefrom;

5 a 4:3 compression adder for receiving each of the sparse carry-save fields of the four  
6 redundant binary numbers, and producing a second sum field therefrom;

7 a 3:2 compression adder for receiving the first sum field, the first carry field and the  
8 second sum field, and producing a third sum field and a second carry field therefrom;

9 wherein the third sum field and the second carry field are the sum of the four redundant  
10 binary numbers.

1 2. An addition circuit according to claim 1, wherein the 4:2 compression adder includes a  
2 cascade of a first full adder and a second full adder.

1 3. An addition circuit according to claim 1, wherein the 4:3 compression adder includes a  
2 binary summer for receiving four input bits of equal weight, and producing a three bit binary  
3 output word representative of the sum of the four input bits.

1 4. An addition circuit according to claim 1, wherein the 3:2 compression adder includes a  
2 full adder.

1 5. An addition circuit according to claim 1, wherein the 4:3 compression adder distributes  
2 bits within the second sum field so as to correspond to the significance of the sparse carry-save  
3 field.

1 6. An addition circuit according to claim 1, wherein each of the four redundant binary  
2 numbers is in radix-16 format, so as to include a sparse carry-save bit for every four operand bits.

1 7. An addition circuit for producing a sum of four redundant binary numbers, wherein each  
2 number includes an operand field and a sparse carry-save field, comprising:

3 means for receiving each of the operand fields of the four redundant binary numbers, and  
4 producing a first sum field and a first carry field therefrom;

5 means for receiving each of the sparse carry-save fields of the four redundant binary  
6 numbers, and producing a second sum field therefrom;

7 means for receiving the first sum field, the first carry field and the second sum field, and  
8 producing a third sum field and a second carry field therefrom;

9 wherein the third sum field and the second carry field are the sum of the four redundant  
10 binary numbers.

1 8. An addition circuit according to claim 7, wherein the means for receiving each of the  
2 operand fields includes a cascade of a first full adder and a second full adder.

1 9. An addition circuit according to claim 7, wherein the means for receiving each of the  
2 carry-save fields includes a binary summer for receiving four input bits of equal weight, and  
3 producing a three bit binary output word representative of the sum of the four input bits.

1 10. An addition circuit according to claim 7, wherein the means for receiving the first sum  
2 field, the first carry field and the second sum field includes a full adder.

1 11. An addition circuit according to claim 7, wherein the means for receiving each of the  
2 carry-save fields distributes the second sum field so as to correspond to the significance of the  
3 sparse carry-save field.

1 12. An addition circuit according to claim 7, wherein each of the four redundant binary  
2 numbers is in radix-16 format, so as to include a sparse carry-save bit for every four operand bits.

1 13. A method of producing a sum of four redundant binary numbers, wherein each number  
2 includes an operand field and a sparse carry-save field, comprising:  
3 receiving each of the operand fields of the four redundant binary numbers, and producing  
4 a first sum field and a first carry field therefrom;  
5 receiving each of the carry-save fields of the four redundant binary numbers, and  
6 producing a second sum field therefrom;  
7 receiving the first sum field, the first carry field and the second sum field, and producing  
8 a third sum field and a second carry field therefrom;  
9 wherein the third sum field and the second carry field are the sum of the four redundant  
10 binary numbers.

1 14. A method according to claim 13, further including using a 4:2 compression adder to  
2 produce the first sum field and the first carry field.

1 15. A method according to claim 13, further including using a 4:3 compression adder to  
2 produce the second sum field.

1 16. A method according to claim 13, further including using a 3:2 compression adder to  
2 produce the third sum field and the second carry field.

1 17. A method according to claim 13, further including distributing bits within the second sum  
2 field so as to correspond to the significance of bits within the sparse carry-save field.

- 1 18. An addition circuit for producing a sum of four redundant binary numbers, wherein each  
2 number includes an operand field and a sparse carry-save field, comprising:  
3 a 4:2 compression adder, including a cascade of a first full adder and a second full adder,  
4 for receiving each of the operand fields of the four redundant binary numbers, and producing a  
5 first sum field and a first carry field therefrom;  
6 a 4:3 compression adder, including a binary summer for receiving four input bits of equal  
7 weight and producing a three bit binary output word representative of the sum of the four input  
8 bits, for receiving each of the carry-save fields of the four redundant binary numbers, and  
9 producing a second sum field therefrom;  
10 a 3:2 compression adder, including a full adder, for receiving the first sum field, the first  
11 carry field and the second sum field, and producing a third sum field and a second carry field  
12 therefrom;  
13 wherein the third sum field and the second carry field are the sum of the four redundant  
14 binary numbers.
- 1 19. A method of producing a sum of four redundant binary numbers, wherein each number  
2 includes an operand field and a sparse carry-save field, comprising:  
3 receiving each of the operand fields of the four redundant binary numbers, and producing,  
4 via a 4:2 compression adder, a first sum field and a first carry field therefrom;  
5 receiving each of the carry-save fields of the four redundant binary numbers, and  
6 producing, via a 4:3 compression adder, a second sum field therefrom;  
7 receiving the first sum field, the first carry field and the second sum field, and producing,  
8 via a 3:2 compression adder a third sum field and a second carry field therefrom;  
9 wherein the third sum field and the second carry field are the sum of the four redundant  
10 binary numbers.

- 1 20. A method of producing a sum of at least two redundant binary numbers, wherein each  
2 number includes an operand field and a sparse carry-save field, comprising:  
3 receiving each of the operand fields of the at least two redundant binary numbers, and  
4 producing a first sum field and a first carry field therefrom;  
5 receiving each of the sparse carry-save fields of the four redundant binary numbers, and  
6 producing a second sum field therefrom, wherein a distribution of bits within the second sum  
7 field corresponds to a sparse distribution within the sparse carry-save fields;  
8 receiving the first sum field, the first carry field and the second sum field, and producing  
9 a third sum field and a second carry field therefrom;  
10 wherein the third sum field and the second carry field are the sum of the four redundant  
11 binary numbers.